

**SECTION 611****WATER, SEWER AND STORM DRAIN TESTING****611.1 DESCRIPTION:**

The testing of new water lines, fire lines, force mains, sewer lines, and storm lines shall conform to the applicable testing procedures and inspection requirements as outlined herein, except as otherwise required on the plans, as modified in the special provisions or as directed by the Contracting Agency.

Water mains shall be isolated, disinfected, sampled and tested to meet the Safe Drinking Water Act Requirements per 40CFR Part 141.

The Contractor shall provide all vents, piping, plugs, bulkheads, valves, bracing, blocking, pumps, and measuring devices and all other equipment necessary for performing the tests including new or good condition pressure gages. If required by the Contracting Agency, Contractor shall pay for water used in the performance of the required flushing and pressure testing. Water quantities used shall be calculated or meter measured as directed and approved by the agency.

Unless otherwise provided for, the Contractor shall notify the Contracting Agency no less than 72 hours to schedule the start of the testing and disinfection cycle.

**611.2 FLUSHING AND HYDROSTATIC TESTING:**

Water lines, fire lines and force mains including all fittings and connections to shall be pressure tested for water-tightness by subjecting each section to hydrostatic testing in accordance with applicable provisions of AWWA ~~C-651~~ C-600 and C-605 (Latest Version), except as modified below.

**611.2.1 Flushing Completed Main Lines:**

- (A) **Flushing Plan:** If required by the Contracting Agency, the Contractor shall submit a written flushing plan for review and approval prior to starting any flushing activities. The plan may be a written detailed narrative or a shop drawing submittal depending on complexity of the system or agency requirements. There may be different plans for initial flushing (debris) and a final flushing (high chlorine). The plan shall include and indicate all locations for the connection feed point, backflow protection device, measuring meter (if required), all valves and fire hydrants, all permanent or temporary air release points, testing/sampling riser ports, discharge outlets, proper de-chlorination procedure (for final flushing) and final disposal location/destination of the flushing water. The plan shall indicate the required sequential phasing to achieve a positive, one directional flushing action. For water lines greater than 16 inches, an engineered flushing plan shall be required.
- (B) **Valve Operation:** Check with the Contracting Agency for any policy regarding the operation of existing valves or other appurtenances.
- (C) **Line Filling:** The test section shall be slowly filled with potable water and all air shall be vented from the line. The rate of filling shall be as determined by the Contracting Agency, with at least 48-hour notice required before tests are scheduled. Measurement and documentation of the volume flow of water into and out of all lines shall be made by means of a pitot gage, meter supplied by the Contracting Agency, volume calculations based on design, system and conditions as monitored and approved by the Contracting Agency or some other pre-approved device/set-up.
- (D) **Preliminary (Debris) Flushing:** All mains 16 inches and smaller shall be flushed using clean potable water, prior to chlorination, as thoroughly as possible with the water pressure and outlets available. Flushing is intended to remove only light debris and should not be relied upon to remove heavy material. Contractors shall exercise care and proper workmanship in the pipe laying operation to not allow dirt and debris to get into the pipe. Dirt, bedding materials, rocks or other foreign debris may cause damage to valves and fire hydrants during flushing operations. When excessive or large

debris is witnessed exiting the outlets during flushing, the valves and fire hydrants shall be further investigated and inspected to verify that they are in good working order.

- (E) Required flow and openings (either taps or hydrants) to flush pipelines at 3.0 ft/sec (40 psi residual pressure in water main) \* Reference AWWA C651 (Latest Version).

### **Recommended Outlet Size Requirements For Flushing**

<u>Main Size</u>	<u>Minimum Outlet Size Required</u>
4" thru 6"	3"
8"	4"
10" thru 16"	6"
Greater than 16"	Engineered Flushing Plan Required

Contracting Agency has final determination of size, number of blow offs and location of flushing inlets and outlets.

**611.2.2 Hydrostatic Testing:** Pressure testing may be performed before or after final backfilling. If the pipe line is properly and safely center-loaded, a visual inspection for leaks may be made along the pipe line while the test section is under test pressure. Any visible leaks shall be repaired and a retest conducted. However, if mechanical compaction is to be used in the backfilling operations per AWWA C-600 and C-605, the pressure tests shall not be performed until final backfilling is 100% completed including compaction. Backfill and compaction shall be 100% complete for any restrained pipe line sections for the entire designated restrained distance prior to pressure testing. All pipe sections, stub laterals, fire hydrant laterals, blow-offs, and valves encompassed in the test section shall be verified to be open, water filled and pressurized. Actual hydrostatic monitor testing shall not begin until the pipe line has been filled entirely with water for at least 24 hours to allow for air venting and absorption.

- (A) **Pressure Testing:** Unless otherwise noted in the contract documents, the minimum prescribed test pressure shall be at least 200 psi for lines smaller than 16 inches and 150 psi for lines 16 inches or larger, not to exceed 5 psi over the minimum prescribed test pressure, as measured at the lowest end of the section under test. The duration of each pressure test shall be at least 2 hours, during which time the test section shall not drop below the minimum prescribed test pressure. If the pressure in the pipe test section has not stabilized by the end of the testing period, a hydrostatic retest will be required.

Each section of a new line between sectionalizing valves or between the last sectionalizing valve and the end of the project shall be tested separately as required in AWWA ~~C-654~~ C-600 and C-605, and/or as modified in these specifications, except that any such section less than 500 feet in length may be tested with the adjacent section, if both sections of line have the same pipe class rating. No section greater than 2,640 feet in total pipe length shall be tested without written permission of the Engineer.

Contractor shall bleed all air out of new lines being tested. After all air has been determined to have been removed and the pressure has stabilized and maintained constant, the line shall be determined to be ready for testing. The Contractor shall furnish all necessary apparatus and assistance to conduct the testing.

- (B) **Testing Allowance / Makeup Water:** If a testing allowance is permitted by the Contracting Agency, the makeup water volume shall be determined after the pressure test has been satisfactorily completed and all backfilling and compaction has been completed to top of trench. The allowance shall be defined as the maximum quantity of additional water necessary to be supplied into the pipe section under test to restore the ending test pressure to the beginning test pressure, after the pipe line has been filled with water and all air expelled.

The duration of each makeup water test shall be at least 2 hours. To pass the allowance testing, the quantity of makeup water from the pipe line shall not exceed the makeup water quantity allowed by the following formula:

$$\frac{A = LD \sqrt{P}}{148,000}$$

Where:

A = testing allowance (makeup water), gallons per hour.

L = length of pipe tested, feet

D = nominal diameter of pipe, inches.

P = test pressure, pounds / square inch

If the pipe line under test contains sections of various diameters, the testing allowance will be the sum of the computed allowance for each size. Should the test on any section of the pipe line require more makeup water than allowed by the above formula, the Contractor shall locate and repair the defective pipe, fittings, or joint until the makeup water volume is within the specified allowance. All repairs and re-tests, if required, shall be made at the Contractor's expense.

### 611.3 DISINFECTING WATER MAINS

**611.3.1 Isolation:** Unless otherwise directed by the Contracting Agency, new water mains shall be physically isolated from active distribution systems until initial disinfection and satisfactory bacteriological results have been completed. The means for protecting active distribution systems from contamination due to reverse flow shall be according to level of protection required by Arizona Administrative Code (A.A.C) R18-4-215. Physical breaks or gaps in the water main line are acceptable; or temporary insertion of a properly sized and certified reduced pressure backflow assembly ("jumper" set-up) is also an acceptable method. Check with Contracting Agency for specific requirements.

**611.3.2 Disinfection:** The method of chlorination used shall be approved by the Contracting Agency and must conform to NSF/ANSI 60 & 61 and the AWWA C651 (Latest Version) Standards. The Contracting Agency shall determine the number and locations for sample risers. The contractor is responsible for supplying equipment to properly dose the new main with a chlorine concentration ~~no lower~~ not less than 10 parts per million (ppm). The Contracting Agency will verify the chlorine level is at 10 ppm at time of dosing and verify that after 24 hours of high chlorine solution sitting in the pipes that the chlorine concentration is at 10 ppm or ~~above~~ greater. All new valves, hydrants and other appurtenances shall be operated fully to ensure full disinfection from the chlorine solution.

After 24-hour verification is complete, the water main shall be completely flushed of the high chlorine concentration. A chlorine neutralizing agent may be required during flushing discharge. Check with the Contracting Agency to confirm.

(A) **Methods of Applying Chlorine:** One of the following methods of application of chlorine shall be used, subject to the approval of the Contracting Agency.

- Liquid chlorine gas-water mixture.
- Calcium or sodium hypochlorite and water mixture.

(B) **Point of Application:** The preferred point of application of the chlorinating agent is at the beginning of the pipe line extension or any valved section of it and through a corporation stop inserted in the top of the newly laid pipe. The water injector for delivering the chlorine-bearing water into the pipe should be supplied from a tap or other potable water source on the pressure side of the gate valve controlling the flow into the pipe line extension.

(C) **Rate of Application:** Water from the existing distribution system or other approved potable water source of supply shall be controlled so the rate of flow shall not exceed 500 gpm, unless approved by the Contracting Agency, through a suitable measuring device into the newly laid pipe line during the application of chlorine. The rate of chlorine solution flow shall be in such proportion to the rate of

water entering the pipe that the chlorine dose applied to the water entering the newly laid pipe shall produce at least 10 ppm of residual chlorine after 24 hours standing in the pipe. This may be expected with an application of 50 ppm, although some conditions may require more.

On lines 12 inches in diameter or less, determination of the rate of flow of water into the line to be treated may be made by starting with the line full of water and measuring the rate of discharge at a hydrant located at the end of the pipe farthest away from the point of chlorine application.

For lines larger than 12 inches in diameter, the disinfection operation is generally started with the line empty.

- (D) **Retention Period:** The highly chlorinated water shall be retained in the pipe long enough to destroy all nonspore-forming bacteria. This period should be at least 24 hours and no more than 48 hours.

If the circumstances are such that less than a 24-hour retention period must be used and upon approval by the Contracting Agency, the chlorine concentration shall be increased to 100 ppm not to exceed 300 ppm and retained for at least 2 hours. Under these conditions, special care should be taken to avoid chemical attack on pipes, valves, hydrants and other appurtenances.

- (E) **Short Pipe Sections / Laterals / Stubs:** For short sections of new pipelines of up to twenty feet or less in length and where the new line cannot be isolated for testing or installation of a temporary backflow and metering set-up is not possible or feasible, the following procedure may be used with Contracting Agency approval on a case-by-case basis. Various modifications may be necessary or required depending on specific circumstances. This does not apply to small diameter domestic copper water services of up to two inches.

1. 100% of all new pipe materials/fittings used in the installation and tie-in from the existing main line to the backflow assembly on fire lines and up to the first meter connection on domestic water lines shall be disinfected. Any new tie-in valves at the main line shall remain completely closed.
2. All new pipe materials/fittings used in the installation and tie-in are to be disinfected by swabbing with a chlorine solution of at least 200 ppm using NSF/ANSI 60 & 61 approved equipment, materials and chemicals. The chlorine solution shall be tested by the Contracting Agency or designated representative to ensure that it meets the strength requirements. Inspector shall witness the swabbing procedure and document results. A new swabbing device should be used for each new line.
3. The new lines and fittings shall remain empty and closed to the atmosphere for 24 hours to allow the high chlorine treatment sufficient time to disinfect.
4. After the 24-hour period, with Contracting Agency supervision, the new valves shall be operated, and the ends of the lines shall be opened at the largest port available to allow initial flushing of the high chlorine solution. The Contracting Agency shall test this first flow of water to verify at least 10 ppm of chlorine is still present. The line can then continue to be sufficiently flushed until the chlorine levels are below 2.0 ppm as verified by the Contracting Agency.
5. The new lateral valves at the main tie-in shall then be closed and remain closed after flushing; the new lateral line shall remain charged with water and allowed to sit for an additional 24 hours.
6. After 24 hours, the Contracting Agency shall check the chlorine residual levels and collect microbiological samples for lab testing as detailed herein. The new lateral valves at the main tie-in shall remain closed until the Contracting Agency receives the laboratory results that show a negative or "Absent" reading for both Total Coliform and E. coli.

**611.3.3 Final Flushing, Sampling and Testing:** Following chlorination, all treated water in the newly laid pipeline shall be thoroughly flushed until the replacement water throughout the new pipeline can be

proved, by laboratory testing, comparable in quality to the water served to the public from the existing water system. Prior to sampling for laboratory testing, the residual chlorine throughout the length of the pipeline shall be reduced to 2.0 ppm or less per Contracting Agency allowances. Once the required residual chlorine level in the pipeline is achieved, bacteriological samples shall be taken as outlined below.

The Contracting Agency or its authorized representative shall collect all samples for testing of the new water mains. To initiate the sampling and testing, the Contractor will present to the Contracting Agency or its authorized agent a written request for such work no later than 48 hours prior to the time when samples are to be taken. Samples shall be taken from a tap and riser located and installed in such a way as to prevent outside contamination. Samples shall never be taken from an unsterilized hose or from fire hydrants.

The number and types of sampling locations shall be per the flushing plan as approved or determined by the Contracting Agency or its authorized agent; and at a minimum, shall be as follows:

- Waterlines up to but less than 150 feet in length require one sampling riser installed as near the end as possible.
- Waterlines 150 feet to 300 feet in length, two sampling risers, one near each end of the line.
- Waterlines 300 feet to 2,640 feet in length, a minimum of three sampling risers. In addition, dead ends on main lines should be represented with a sampling riser.
- Waterlines greater than 2,640 feet in length shall require a minimum of one additional sampling riser per 1,000 feet.

The Contractor shall install the correct type of sampling risers at the locations shown on the approved flushing plan; or as otherwise directed by the Contracting Agency or its authorized agent. Sampling risers must be at least 18 inches above grade and no more than 48 inches above grade. Sampling risers can be attached to service line curb stops, line blow-off outlets, tapped end-of-line caps, permanent industrial sampling stations or sampling specific taps (saddle, corp stop & riser). Sampling risers shall be made of rigid NSF/ANSI 60 & 61 approved piping material for potable water. The sampling riser outlet must be able to adjust the flow of water and shall not contain inside or outside threads. The sampling riser outlet shall be pointed downward perpendicular to the ground.

The specific method or combination of methods, sequencing, number of required samples at each sampling location and minimum wait times shall be determined by the Contracting Agency or its authorized agent. Some Contracting Agencies may require two sample sets and require or allow different wait times before samples can be taken. For two sample sets, allow 15 minutes between sampling times. The standard sampling methods are listed as follows:

- (A) One sample (or set of samples) from each sampling location taken 24 hours after flushing high chlorine and no water use is examined in the laboratory using the Total Coliform (TC) method.
- (B) Two samples taken on separate days from each sampling location. An additional sample (or set of samples) is taken after an additional 24 hours and no water use is examined in the laboratory using the Total Coliform (TC) method.
- (C) Standard heterotrophic plate count (HPC) test. Samples shall be taken at the same location, and time, as the Total Coliform samples. At a minimum, each HPC test result must be reported as less than 500 CFU/ml or at a limit established by the Contracting Agency.

Laboratory and field analysis shall be done by methods approved by the Arizona Department of Health Services (ADHS).

Upon completion of laboratory testing, results of all tests shall be sent by the designated laboratory to the Contracting Agency. Results of laboratory analysis will be interpreted by the Contracting Agency and reported back to the Contractor. Under no circumstances shall the Contractor contact the laboratory. If there is a need to obtain test results before the actual written reports are submitted, such information shall be obtained only from the Contracting Agency. All reported test results must show a negative or "Absent" reading for both Total Coliform and E. coli.

If any sample in the initial treatment fails to pass the Total Coliform or HPC tests, all sample locations shall be resampled and retested at the Contractor's expense using the duplicate disinfection procedures listed above and shall be repeated until satisfactory results are obtained.

**611.3.4 Final Connections:** Any temporary air release blow-offs and test sampling risers shall be left exposed, accessible and protected during backfill operations until all testing is complete. After all testing has been completed and passed acceptance, all temporary blow-offs and sampling risers shall be properly lowered and terminated as directed by the Contracting Agency.

Connections to existing pipelines or existing valves shall not be made until after all new pipe main line or specific sections thereof, has satisfactorily passed all required hydrostatic and disinfection tests and the Contracting Agency gives approval to make the final connections and put new water mainline into service.

DRAFT